United States Naval Academy
Mechanical Engineering Department

EM217 Strength of Materials

Catalog Description: EM217 Strength of Materials **Credit:** 4 (3-2-4)

A first course in mechanics of deformable bodies with emphasis on the engineering approach to the responses of these bodies to various types of loadings. Topics include stress-strain relationships, stress-strain analysis, stress and strain transformation (Mohr's circle), load-deflection, bending, torsion, buckling, and temperature effects.

Prerequisites: EM211 Statics
Corequisites: SM212 Differential Equations

Textbooks: Riley, Sturges and Morris, Mechanics of Materials, Fifth Edition, John Wiley & Sons, 1999.

Course Director: Professor James A. Joyce

Objectives[1]:

1. The student will learn how the application of forces, temperature changes, and pressures affect deformable bodies (a,b,c).
2. The student will learn how to inter-relate applied load, transmitted load, stress, strain, deformation, and displacement for deformable bodies (a,b,c).
3. The student will learn how to transform stress and strain components to principal axes and to calculate the principal stresses and maximum shear stresses and the principal strains and maximum shearing strain (a,b,c).
4. The student will measure strains in laboratory using strain gages and calculate the corresponding stresses and principal stresses, presenting the results in standard technical report format (a,b,c,d).
5. The student will be taught how to predict stress components resulting from standard axial, torsional, and bending loadings (a,b,c).
6. The student will predict the deformation of axial members, torsional members, and bending members resulting from standard and combined loadings (a,b,c).
7. The student will learn how to predict buckling of axially loaded structural elements (a,b,c).

Course Content:

No.	Topic or Subtopic	hrs.
1	Statics review and review of sectioning	4
2	Introduction to stress and stress components	2
3	Stress on inclined planes	1
4	Stress transformation	2
5	Mohr's circle of plane stress	4
6	Introduction to strain and strain components	1
7	Strain transformation	1

8	Mohr's circle of strain	1
9	Strain gage rosette analysis	1
10	Tensile mechanical properties	3
11	Stress-strain relationships	1
12	Thermal strain	1
13	Design loads and factors of safety	1
14	Deformation of axially loaded members	1
15	Statically indeterminant axially loaded members	1
16	Stress concentrations	2
17	Thin walled pressure vessels	2
18	Torsion	6
19	Beam bending, stress-strain	11
20	Combined loading	6
21	Beam deflection	7
22	Statically indeterminant beams	1
22	Beam design	3
23	Buckling	2

Evaluation:

1. Quizzes
2. Homework
3. Exams
4. Laboratory Reports
6. Design Reports

Acquired Abilities[2]:

1. Student will learn how the application of forces, pressures, and temperature changes affects the shape of deformable bodies. (1,2,3,4)
2. Students will demonstrate knowledge of the definitions of stress and strain. (1,2,3,4)
3. Students will demonstrate a knowledge of stress-strain relationships. (1,2,3,4)
4. Students will demonstrate the ability to transform stress and strain components using equations, and using the Mohr's circle construction. (1,2,3,4)
5. Students will understand the concepts of principal stresses, principal strains, maximum shear stress, and maximum shear strain. (1,2,3,4)
6. Students will demonstrate knowledge of predicting stresses and strains in structural elements undergoing axial loading (including thin-walled pressure vessels).
7. Students will demonstrate knowledge of predicting stresses and strains in structural elements undergoing torsional loading. (1,2,3,4)
8. Students will demonstrate knowledge of predicting stresses and strains in structural elements undergoing bending loading. (1,2,3,4)
9. Students will demonstrate knowledge of predicting stresses and strains in structural elements undergoing combined loading. (1,2,3,4)
10. Students will demonstrate the ability to obtain the elastic curve of elastic beam deflection. (1,2,3,4)
11. Students will demonstrate the ability to solve statically indeterminant problems. (1,2,3)

12. Students will demonstrate the ability to integrate strength as well as deformation considerations in design applications. (1,2,3,6).
13. The student will demonstrate the ability to predict the buckling load for cases of long thin columns loaded axially. (1,2,3)
14. Students will become familiar with the experimental measurement of strain in the engineering laboratory and be able to demonstrate how these measurements are used to validate the predicted stresses in the structural element or structure. (4)
15. Students will demonstrate the ability to write complete and accurate technical reports that describe the experiments conducted. (4)

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[1] Letters in parenthesis refer to the Program Objectives of the Mechanical Engineering Program.
[2] Numbers in parenthesis refer to the evaluation methods used to assess student performance.